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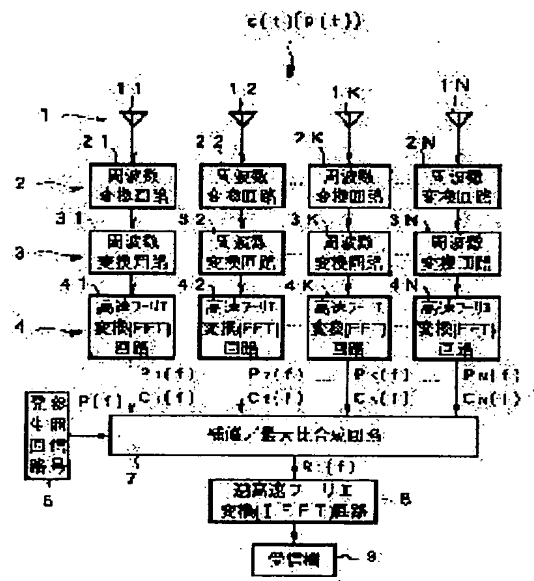
(54) DIVERSITY RECEIVER

(57)Abstract:
PROBLEM TO BE SOLVED: To suppress the effect due to multi-path and frequency selective fading onto the entire reception signal.

SOLUTION: A reception antenna group 1 receives a signal c(t) on which a reference signal p(t) is multiplexed. Frequency conversion circuit groups 2, 3 apply frequency conversion to respective reception signals into signals of a prescribed band. A fast Fourier transformation(FFT) group 4 distributes respective transformation signals from the frequency conversion circuit group 3 into sub bands of the frequency region. A compensation/maximum synthesis circuit 7 conducts the compensation and maximum ratio synthesis of respective sub band division signals based on a transfer function of the transmission line including the reception antenna in the lump to provide an output of a synthesis reception signal R1 (f).



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CLAIMS

[Claim(s)]

[Claim 1] Two or more receiving antennas which receive the signal by which multiplex was carried out in the reference signal by the transmitting side. The conversion means which carries out frequency conversion of each input signal by two or more of these receiving antennas to the signal of a predetermined band. It is diversity-reception equipment equipped with the above, and it carries out having provided a synthetic output means carries out by putting in block a division means divide each conversion signal from the aforementioned conversion means into the sub band of a frequency domain, and the compensation and the maximum ratio composition based on a transfer function of the transmission line which contains the aforementioned receiving antenna about each sub band division signal acquired by the aforementioned division means, and output a synthetic input signal as the feature.

[Claim 2] The aforementioned synthetic output means includes a reference signal generation means to generate other reference signals which changed the aforementioned reference signal and the signal of a same waveform into the frequency-domain signal. The input signal and reference signal of a frequency domain which were acquired from each input signal by two or more aforementioned receiving antennas, And diversity reception equipment according to claim 1 characterized by outputting the aforementioned synthetic input signal using other reference signals of the aforementioned frequency domain from the aforementioned reference signal generation means.

[Claim 3] The signal by which multiplex was carried out in the aforementioned reference signal is diversity reception equipment according to claim 1 or 2 characterized by providing the means which the aforementioned division means consists of two or more fast-Fourier-transform circuits, and carries out the reverse fast Fourier transform of the output from the aforementioned synthetic output means while being a single carrier modulating signal.

[Claim 4] The aforementioned single carrier modulating signal is diversity reception equipment according to claim 3 characterized for the aforementioned reference signal by Time Division Multiplexing or carrying out spread-spectrum multiplex.

[Claim 5] The signal by which multiplex was carried out in the aforementioned reference signal is diversity reception equipment according to claim 1 or 2 with which the aforementioned division means is characterized by the bird clapper from two or more fast-Fourier-transform circuits while being a rectangular frequency multiplex modulation signal.

[Claim 6] The aforementioned rectangular frequency multiplex modulation signal is diversity reception equipment according to claim 5 characterized for the aforementioned reference signal by Time Division Multiplexing or carrying out spread-spectrum multiplex.

[Claim 7] Diversity reception equipment equipped with the conversion means which carries out frequency conversion of each input signal by two or more receiving antennas which are characterized by providing the following, and which receive a transmission signal, and two or more of these receiving antennas to the signal of a predetermined band. A division means to divide each conversion signal from the aforementioned conversion means into the sub band of a frequency domain. A synthetic output means to carry out by putting the maximum ratio composition in block about each sub band division signal acquired by the aforementioned division means, and to output a synthetic input signal.

[Claim 8] The aforementioned synthetic output means is diversity reception equipment according to claim 7 characterized by outputting the aforementioned synthetic input signal using the signal from the aforementioned differential recovery / amplitude compensation means including the differential recovery / amplitude compensation means which gets over [differential-] and compensates [amplitude-] the signal from the aforementioned division means.

[Claim 9] The aforementioned transmission signal is diversity reception equipment according to claim 7 characterized by being a rectangular frequency multiplex differential modulation signal.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] About diversity reception equipment, especially this invention relates to the diversity reception equipment for mitigating a multi-pass and frequency-selective phasing, when carrying out move reception of ground system wide band communication or the broadcast.
[0002]
[Description of the Prior Art] The three synthetic receiving methods of gain composition, such as selection composition, and the maximum ratio composition are learned as a fundamental synthetic receiving method of the diversity reception equipment used in order to mitigate the influence of phasing by move reception etc. conventionally (D.G.Brennan: "Linear diversity combining techniques", Proc.IRE, 47, and pp.1075-1102 (June 1959)).
[0003]
[Problem(s) to be Solved by the Invention] However, by the synthetic receiving method in conventional diversity reception equipment, even if the level fall of the whole input signal is improvable, the level fall of a part of input-signal spectrum is not improvable. That is, although the improvement effect over the narrow-band signal used as the level fall of the whole input signal was large even if it received the same multi-pass and same phasing, the improvement effect over a wide band signal which a level fall produces in a part of input-signal spectrum was seldom expectable.
[0004] this invention aims at offering the diversity reception equipment which can acquire a big improvement effect like the case of narrow-band signal reception, when it accomplished in view of the above-mentioned point and receives a wide band signal under a multi-pulse or phasing environment.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the equipment of this invention Two or more receiving antennas which receive the signal by which multiplex was carried out in the reference signal by the transmitting side, It is diversity reception equipment equipped with the conversion means which carries out frequency conversion of each input signal by two or more of these receiving antennas to the signal of a predetermined band. A division means to divide each conversion signal from the aforementioned conversion means into the sub band of a frequency domain, It considered as the composition possessing a synthetic output means to carry out by putting in block the compensation and the maximum ratio composition based on a transfer function of the transmission line which contains the aforementioned receiving antenna about each sub band division signal acquired by the aforementioned division means, and to output a synthetic input signal.
[0006] Moreover, with the equipment of this invention, the aforementioned synthetic output means includes a reference signal generation means to generate other reference signals which changed the aforementioned reference signal and the signal of a same waveform into the signal of a frequency domain. It considered as the composition which outputs the aforementioned synthetic input signal using the input signal of the frequency domain acquired from each input signal by two or more aforementioned receiving antennas, a reference signal, and other reference signals of the aforementioned frequency domain from the aforementioned reference signal generation means.
[0007] Moreover, with the equipment of this invention, the aforementioned division means consisted of two or more fast-Fourier-transform circuits, and the signal by which multiplex was carried out in the aforementioned reference signal considered it as the composition possessing the means which carries out the reverse fast Fourier transform of the output from the aforementioned synthetic output means while being a single carrier modulating signal.
[0008] Moreover, with the equipment of this invention, the aforementioned single carrier modulating signal considered the aforementioned reference signal as Time Division Multiplexing or the composition by which spread-spectrum multiplex is carried out.
[0009] Moreover, with the equipment of this invention, while the signal by which multiplex was carried out was a rectangular frequency multiplex modulation signal, the aforementioned division means considered the aforementioned reference signal as the composition which consists of two or more fast-Fourier-transform circuits.
[0010] Moreover, with the equipment of this invention, the aforementioned rectangular frequency multiplex modulation signal considered the aforementioned reference signal as Time Division Multiplexing or the composition by which spread-spectrum multiplex is carried out.
[0011] Moreover, two or more receiving antennas to which the equipment of this invention receives a transmission signal, It is diversity reception equipment equipped with the conversion means which carries out frequency conversion of each input signal by two or more of these receiving antennas to the signal of a predetermined band. It

considered as the composition possessing a division means to divide each conversion signal from the aforementioned conversion means into the sub band of a frequency domain, and a synthetic output means to carry out by putting the maximum ratio composition in block about each sub band division signal acquired by the aforementioned division means, and to output a synthetic input signal.
[0012] Moreover, with the equipment of this invention, the aforementioned synthetic output means was considered as the composition which outputs the aforementioned synthetic input signal using the signal from the aforementioned differential recovery / amplitude compensation means including the differential recovery / amplitude compensation means which gets over [differential-] and compensates [amplitude-] the signal from the aforementioned division means.
[0013] Moreover, with the equipment of this invention, the aforementioned transmission signal was taken as the composition which is a rectangular frequency multiplex differential modulation signal.
[0014]
[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained in detail, referring to an accompanying drawing.
[0015] (Gestalt of the 1st operation) Drawing 1 is the block diagram showing the gestalt of operation of the 1st of the diversity reception equipment by this invention.
[0016] The diversity reception equipment of drawing 1 is an example of the diversity reception equipment of the sub band division composite system corresponding to [in the reference signal with the flat frequency characteristics, such as a chirp, sinx/x, and false random noise,] reception of single carrier modulating signals, such as the Time Division Multiplexing or AM, PM and FM and the PSK modulation by which spread-spectrum multiplex was carried out, QAM (Quadrature Amplitude Modulation : quadrature amplitude modulation), and a VSB (Vestiginal Sideband : vestigial sideband) modulation, at the transmitting side.
[0017] In addition, the example which carries out Time Division Multiplexing of the signal carried out based on the chirp signal, and uses it as a reference signal for ghost removal (GCR signal) is looked at by U.S. Pat. No. 5,121,211 (David Koo, June 9, 1992). Moreover, the example to which sinx/x is applied as a GCR signal is looked at by H.Miyazawa, et al: "Development of a Ghost Cancel Reference Signal for TV Broadcasting", IEEE Trans.BC-35, 4, and pp.339-347 (Dec.1989).
[0018] The receiving-antenna group 1 in which the diversity reception equipment shown in drawing 1 constitutes diversity from two or more receiving antennas, The frequency-changing-circuit group 2 which changes into an intermediate frequency (IF) band each RF (RF) input signal received from each receiving antenna, The frequency-changing-circuit group 3 which carries out frequency conversion of these input signals changed into IF band to baseband signaling, The fast-Fourier-transform (FFT) circuit group 4 which changes such baseband signaling into a frequency-domain signal, The reference signal generating circuit 6 which generates other reference signal P (f) which changed into the frequency-domain signal the reference signal by which multiplex was carried out to the sending signal, and the signal of a same waveform, The reference signal changed into the frequency-domain signal, an input signal, and the compensation / maximum ratio composition circuit 7 which performs compensation and the maximum ratio composition using other reference signal P (f) of the reference signal generating circuit 6, It has the reverse fast-Fourier-transform (IFFT) circuit 8 which changes the maximum-ratio[compensation and]-compounded input signal into a time-domain signal, and the receiver 9 which restores to the input signal transformed inversely by the time domain, and a sub band division composite system performs synthetic reception of each input signal which carried out diversity reception.
[0019] The receiving-antenna group 1 consists of receiving antennas 11 and 12, --1K, --1N, and receives reference signal p (t) by which multiplex was carried out to single carrier modulating-signal c (t) which received a multi-pass and phasing. Here, each receiving antennas 11 and 12 of the receiving-antenna group 1, --1K, --1N, in order to lessen correlation between input signals, it shall be made to estrange more than the half-wave length of the subcarrier of an input signal mutually, and shall arrange. Moreover, let the reference signal by which multiplex is carried out by the transmitting side be the signal and same waveform which changed into the time domain other reference signals generated by the reference signal generating circuit 6 of a receiving side. The reference signal which each receiving antennas 11 and 12, --1K, --1N receive serves as the frequency characteristic different generally as below-mentioned by disorder of the frequency characteristic by the multi-pass or frequency-selective phasing.
[0020] The frequency-changing-circuit group 2 consists of frequency changing circuits 21 and 22, --2K, --2N, and changes into an IF signal reference signal p (t) received by each receiving antennas 11 and 12, --1K, --1N from RF signal. The frequency band of an IF signal is set up beforehand. The frequency-changing-circuit group 3 consists of frequency changing circuits 31 and 32, --3K, --3N, and carries out frequency conversion of the IF signal to baseband signaling. Reference signal [from each receiving antennas 11 and 12 changed into baseband signaling, --1K, --1N] p (t) is the reference signal of a frequency domain, respectively by the fast-Fourier-transform (FFT) circuit group 4 which consists of the fast-Fourier-transform circuits 41 and 42, --4K, --4N.
P1 (f) and P2 (f) --Pk (f) and --PN (f) (1)
It is alike and is changed. (1) Reference signal Pk of the frequency domain of a formula (f), and (k= 1, ...N) carry out the discrete Fourier transform of the input signal of each receiving antenna, and have become what was divided into the sub band of a frequency domain.
[0021] Here, drawing 2 is the reference signal P1 of the frequency domain acquired from reference signal [of the frequency domain which the reference signal generating circuit which a transmitting side has generated] P (f), and

reference signal [from each receiving antennas 11 and 12, --1K, --1N] p (t). (f) and P2 (f) --Pk (f) and --PN It is drawing showing an example of (f).
[0022] Reference signal Pk of the frequency domain acquired from reference signal [from each receiving antennas 11 and 12, --1K, --1N] p (t) as shown in drawing 2 (f) is different from reference signal P (f) which the reference signal generating circuit which a transmitting side has by disorder of the frequency characteristic by the multi-pass or frequency-selective phasing generated, and becomes the frequency characteristic different, respectively generally. Since it is separated [from this] of each receiving antenna more than the half-wave length of the subcarrier of an input signal, it is for correlation between the phases of the electric wave which carries out ingress to each receiving antenna to become low, and for phase contrast to arise between a subcarrier and a multi-pass.
[0023] Then, while utilizing for the maximum the portion which excelled [compound / maximum-ratio-/ the input signal of the frequency domain from each receiving antenna / for every band] in the receiving property, the good synthetic input signal which suppressed the influence of a phase supplement, a multi-pass, or frequency-selective phasing for disorder of a receiving property can be obtained.
[0024] The reference signal of the frequency domain which became the basis of received reference signal p (t) here, Namely, the transmission line at the time of setting other reference signals of the reference signal generating circuit 6 to P (f), and receiving by receiving-antenna 1K (from generating of the reference signal in a transmitting side) It is Hk about a transfer function after receiving by receiving-antenna 1K until it is changed into a frequency domain by fast-Fourier-transform circuit 4K. If (f), and (k= 1, ...N) Reference signal Pk of the frequency domain by receiving-antenna 1K (f) (k= 1, ...N) Pk (f) =Hk (f) P (f) (2)
It becomes.
[0025] Moreover, the receiving-antenna group 1 which constitutes diversity receives single carrier modulating-signal c (t), and received single carrier modulating-signal c (t) is changed into an IF signal from RF signal by the frequency-changing-circuit group 2. If frequency conversion of the IF signal is furthermore carried out to baseband signaling by the frequency-changing-circuit group 3, the input signal from each receiving antennas 11 and 12 changed into baseband signaling, --1K, --1N is the input signal Ck of a frequency domain by the fast-Fourier-transform (FFT) circuit group 4. (f) (k= 1, ...N)
C1 (f) and C2 (f) --Ck (f) --CN (f) (3)
It is alike and is changed.
[0026] Input signal Ck of the frequency domain according to receiving-antenna 1K first in compensation / maximum ratio composition circuit 7 To (f), for every band by which sub band division was carried out, it sets to a frequency domain and is a transfer function Hk. It can compensate using (f) (waveform equalization). It is Ek about the signal after compensation. If (f) Ek (f) =Ck (f)/Hk (f) (k= 1, ...N) (4)
It becomes. Transfer function Hk searched for by the formula (2) If (f) is substituted for a formula (4) Ek (f) =P (f) Ck (f)/Pk (f) (5)
It becomes.
[0027] signal Ek with which the reception output of each receiving antenna was compensated here (f) (-- k= -- reference signal Pk which changed into the frequency-domain signal 1, 2, --, the reference signal received by each receiving antenna in N) (f) (-- k= -- the well-known maximum ratio composition is performed 1, 2, --, by carrying out weighting by N) Namely, synthetic input signal R1 of a frequency domain (f) is [0028].
[Equation 1]

$$R_1(f) = \frac{\sum_{k=1}^{N} |P_k(f)|^2 E_k(f)}{\sum_i |P_i(f)|^2} \qquad (6)$$

[0029] Here, it is denominator sigma|Pi. (f) |2 It is a standardization coefficient. It is [0030] when a formula (5) is substituted for a formula (6).
[Equation 2]

$$R_1(f) = \frac{P(f) \sum_{k=1}^{N} P_k^*(f) C_k(f)}{\sum_i |P_i(f)|^2} \qquad (7)$$

[0031] It becomes. However, Pk* (f) is the reference signal Pk. The complex conjugate of (f) is shown.
[0032] Namely, the reference signal and input signal which were changed into the frequency domain acquired from the fast-Fourier-transform (FFT) circuit group 4, And the same other reference signal P (f) as the reference signal of the frequency domain which became the basis of received reference signal p (t) which was generated from the reference signal generating circuit 6 is used. If it carries out by summarizing an operation as shown in a formula (7) in compensation / maximum ratio composition circuit 7, they will be collectively made by compensation and the maximum ratio composition about all the bands for every band where sub band division of the input signal was carried out.

[0033] Standardization coefficient sigma|Pi (f) |2 The probability that this will serve as zero although the synthetic reception output of all the receiving antennas at the time of receiving a reference signal is shown is the reference signal Pk by the independent receiving antenna. It is a low from the probability that (f) will become zero. Therefore, after compensating the reception output by each receiving antenna using a formula (5), the probability that it will become impossible calculating the direction performed about the reception output of each receiving antenna by putting compensation and the maximum ratio composition in block using a formula (7) rather than performing the maximum ratio composition separately is low, and stable operation can be expected.
[0034] Since the maximum-ratio-compounded input signal is a signal of a frequency domain, it is returned to the signal of a time domain by the reverse fast-Fourier-transform (IFFT) circuit 8, and restores to the signal transformed inversely by the time domain with a receiver 9.
[0035] Thus, according to the gestalt of this operation, frequency conversion of the single carrier modulating signal to which multiplex [of the reference signal received by the receiving-antenna group 1] was carried out is carried out to baseband signaling. A reference signal and an input signal are changed into the signal of a frequency domain by the fast-Fourier-transform (FFT) circuit 4. After compensation / maximum ratio composition circuit 7 performs compensation / maximum ratio composition for every band using the reference signal acquired from the reference signal generating circuit 6, By performing the usual recovery, after transforming inversely to the signal of a time domain by the reverse fast-Fourier-transform (IFFT) circuit 8 By the synthetic receiving method in the conventional diversity reception, the influence of the intersymbol interference by the multi-pass and frequency-selective phasing which have not been removed can be suppressed.
[0036] (Gestalt of the 2nd operation) Drawing 3 is the block diagram showing the gestalt of operation of the 2nd of the diversity reception equipment by this invention.
[0037] The diversity reception equipment shown in drawing 3 is an example of the diversity reception equipment of the sub band division composite system corresponding to [in the reference signal with the flat frequency characteristics, such as a chirp, sinx/x, and false random noise,] Time Division Multiplexing or the reception of an OFDM (rectangular frequency multiplex : Orthogonal Frequency DivisionMultiplex) modulation-technique signal by which spread-spectrum multiplex was carried out at the transmitting side.
[0038] The receiving-antenna group 1 in which the diversity reception equipment shown in drawing 3 constitutes diversity from two or more receiving antennas, The frequency-changing-circuit group 2 which changes into an intermediate frequency (IF) band each RF (RF) input signal received from each receiving antenna, The frequency-changing-circuit group 3 which carries out frequency conversion of these input signals changed into IF band to baseband signaling, The fast-Fourier-transform (FFT) circuit group 4 which changes such baseband signaling into a frequency-domain signal, The reference signal generating circuit 6 which generates reference signal P (f) which changed into the frequency-domain signal the reference signal by which multiplex was carried out to the sending signal, and the signal of a same waveform, Compensation / maximum ratio composition circuit 7a which performs compensation and the maximum ratio composition using other reference signal P (f) of the reference signal changed into the frequency-domain signal, an input signal, and the reference signal generating circuit 6, It has receiver 9a which restores to the input signal of the maximum-ratio[compensation and]-compounded frequency domain, and a sub band division composite system performs synthetic reception of each input signal which carried out diversity reception.
[0039] The receiving-antenna group 1 is the OFDM modulating signal co which consists of receiving antennas 11 and 12, --1K, --1N, and received a multi-pass and phasing. Reference signal p (t) by which multiplex was carried out to (t) is received. Here, each receiving antennas 11 and 12 of the receiving-antenna group 1, --1K, --1N, in order to lessen correlation between input signals, it shall be made to estrange more than the half-wave length of the subcarrier of an input signal mutually, and shall arrange. Moreover, let the reference signal by which multiplex is carried out by the transmitting side be the signal and same waveform which changed into the time domain other reference signals generated by the reference signal generating circuit 6 of a receiving side. The reference signal which each receiving antennas 11 and 12, --1K, --1N receive serves as the frequency characteristic different generally as below-mentioned by disorder of the frequency characteristic by the multi-pass or frequency-selective phasing.
[0040] The frequency-changing-circuit group 2 consists of frequency changing circuits 21 and 22, --2K, --2N, and changes into an IF signal reference signal p (t) received by each receiving antennas 11 and 12, --1K, --1N from RF signal. The frequency band of an IF signal is set up beforehand. The frequency-changing-circuit group 3 consists of frequency changing circuits 31 and 32, --3K, --3N, and carries out frequency conversion of the IF signal to baseband signaling. Reference signal [from each receiving antennas 11 and 12 changed into baseband signaling, --1K, --1N] p (t) is the reference signal of a frequency domain, respectively by the fast-Fourier-transform (FFT) circuit group 4 which consists of the fast-Fourier-transform circuits 41 and 42, --4K, --4N.
P1 (f) and P2 (f) --Pk (f) and --PN (f) (8)
It is alike and is changed.
[0041] (8) Reference signal Pk of the frequency domain of a formula (f), and (k= 1, ...N) carry out the discrete Fourier transform of the input signal of each receiving antenna, and have become what was divided into the sub band of a frequency domain.
[0042] Reference signal Pk of the frequency domain acquired from reference signal [from each receiving antennas 11 and 12, --1K, --1N] p (t) by disorder of the frequency characteristic by the multi-pass or frequency-selective phasing at this time (f) becomes the frequency characteristic which is generally different as shown in drawing 2 .

Since it is separated [from this] of each receiving antenna more than the half-wave length of the subcarrier of an input signal, it is for correlation between the phases of the electric wave which carries out ingress to each receiving antenna to become low, and for phase contrast to arise between a subcarrier and a multi-pass. Then, while utilizing for the maximum the portion which excelled [compound / maximum-ratio-/ the input signal from each receiving antenna / for every band] in the receiving property, the good synthetic input signal which suppressed the influence of a phase supplement, a multi-pass, or frequency-selective phasing for disorder of a receiving property can be obtained.

[0043] The reference signal of the frequency domain which became the basis of received reference signal p (t) here, Namely, the transmission line at the time of setting other reference signals of the reference signal generating circuit 6 to P (f), and receiving by receiving-antenna 1K (from generating of the reference signal in a transmitting side) It is Hk about a transfer function after receiving by receiving-antenna 1k until it is changed into a frequency domain by fast-Fourier-transform circuit 4K. If (f), and (k= 1, ...N) Reference signal Pk of the frequency domain by receiving-antenna 1K (f) (k= 1, ...N) Pk (f) =Hk (f) P (f) (9)

It becomes.

[0044] Moreover, OFDM modulating signal co OFDM modulating signal co which received (t) by the receiving-antenna group 1 which constitutes diversity, and was received (t) is changed into an IF signal from RF signal by the frequency-changing-circuit group 2. Each receiving antennas 11 and 12 changed into baseband signaling when frequency conversion of the IF signal was furthermore carried out to baseband signaling by the frequency-changing-circuit group 3, —1K, —1N The input signal of a shell is the input signal Cok of a frequency domain (f) (k= 1, ...N) by the fast-Fourier-transform (FFT) circuit group 4.

Co1(f) Co2(f) —Cok(f) —CoN (f) (10)

It is alike and is changed.

[0045] In compensation / maximum ratio composition circuit 7a, it sets to a frequency domain first for every band by which sub band division was carried out to the input signal Cok of the frequency domain by receiving-antenna 1K (f), and is a transfer function Hk. It can compensate using (f) (waveform equalization). If the signal after compensation is set to Eok (f) Eok(f) =Cok(f)/Hk (f) (11)

It becomes. Transfer function Hk searched for by the formula (9) If (f) is substituted for a formula (11) Eok(f) =P (f) Cok (f)/Pk (f) (12)

It becomes.

[0046] Signal Eok (f) (which compensated the reception output of each receiving antenna here — k= — reference signal Pk which changed into the frequency-domain signal 1, 2, —, the reference signal received by each receiving antenna in N) (f) (— k= — the well-known maximum ratio composition is performed 1, 2, —, by carrying out weighting by N) Namely, synthetic input signal R2 of a frequency domain (f) is [0047].

[Equation 3]

$$R_2(f) = \frac{\sum_{k=1}^{N} |P_k(f)|^2 E_{ok}(f)}{\sum_i |P_i(f)|^2} \qquad (13)$$

[0048] Here, it is denominator sigma|Pi. (f) |2 It is a standardization coefficient. It is [0049] when a formula (12) is substituted for a formula (13).

[Equation 4]

$$R_2(f) = \frac{P(f) \sum_{k=1}^{N} P_k^*(f) C_{ok}(f)}{\sum_i |P_i(f)|^2} \qquad (14)$$

[0050] It becomes. However, Pk* (f) is the reference signal Pk. The complex conjugate of (f) is shown.

[0051] Namely, the reference signal and input signal which were changed into the frequency domain acquired from the fast-Fourier-transform (FFT) circuit group 4, And the same reference signal P (f) as the reference signal of the frequency domain which became the basis of transmitted reference signal p (t) which was generated from the reference signal generating circuit 6 is used. If an operation as shown in a formula (14) in compensation / maximum ratio composition circuit 7a is put in block and performed, compensation and the maximum ratio composition will be made about all the bands for every band where sub band division of the input signal was carried out.

[0052] Standardization coefficient sigma|Pi (f) |2 The probability that this will serve as zero although the synthetic reception output of all the receiving antennas at the time of receiving a reference signal is shown is the reference signal Pk by the independent receiving antenna. It is lower than the probability that (f) will become zero. Therefore, after compensating the reception output by each receiving antenna using a formula (12), the probability that it will become impossible calculating the direction performed about the reception output of each receiving antenna by putting compensation and the maximum ratio composition in block using a formula (14) rather than performing the maximum ratio composition separately is low, and stable operation can be expected. It restores to the input signal of

the maximum-ratio-compounded frequency domain by receiver 9a.
[0053] Thus, according to the gestalt of this operation, frequency conversion of the OFDM modulating signal to which multiplex [of the reference signal received by the receiving-antenna group 1] was carried out is carried out to baseband signaling. A reference signal and an input signal are changed into the signal of a frequency domain by the fast-Fourier-transform (FFT) circuit 4. By getting over, after compensation / maximum ratio composition circuit 7a performs compensation / maximum ratio composition for every band using the reference signal acquired from the reference signal generating circuit 6 In the composite system in the conventional diversity reception, the influence of the intersymbol interference by the multi-pass and frequency-selective phasing which have not been removed can be suppressed.
[0054] (Form of the 3rd operation) Drawing 4 is the block diagram showing the form of operation of the 3rd of the diversity reception equipment by this invention.
[0055] The diversity reception equipment shown in drawing 4 is an example of the diversity reception equipment of the sub band division composite system corresponding to reception of an OFDM differential modulation method signal.
[0056] The receiving-antenna group 1 in which the diversity reception equipment shown in drawing 4 constitutes diversity from two or more receiving antennas, The frequency-changing-circuit group 2 which changes into an intermediate frequency (IF) band each RF (RF) input signal received from each receiving antenna, The frequency-changing-circuit group 3 which carries out frequency conversion of these input signals changed into IF band to baseband signaling, The fast-Fourier-transform (FFT) circuit group 4 which changes such baseband signaling into a frequency-domain signal, The differential recovery / amplitude compensating circuit 5 which gets over [differential-] and compensates [amplitude-] the input signal changed into these frequency-domain signals, It has the maximum ratio composition circuit 10 which maximum-ratio-compounds these input signals by which differential recovery and amplitude compensation were carried out, and receiver 9a which restores to the input signal of the maximum-ratio-compounded frequency domain, and a sub band division composite system performs synthetic reception of each input signal which carried out diversity reception.
[0057] The receiving-antenna group 1 consists of receiving antennas 11 and 12, --1K, --1N, and receives the OFDM differential modulation signal cod (t) which received a multi-pass and phasing. Here, each receiving antennas 11 and 12 of the receiving-antenna group 1, --1K, --1N, in order to lessen correlation between input signals, it shall be made to estrange more than the half-wave length of the subcarrier of an input signal mutually, and shall arrange.
[0058] The frequency-changing-circuit group 2 consists of frequency changing circuits 21 and 22, --2K, --2N, and changes into an IF signal the input signal received by each receiving antennas 11 and 12, --1K, --1N from RF signal. The frequency band of an IF signal is set up beforehand. The frequency-changing-circuit group 3 consists of frequency changing circuits 31 and 32, --3K, --3N, and carries out frequency conversion of the IF signal to baseband signaling. The input signal from each receiving antennas 11 and 12 changed into baseband signaling, --1K, --1N is the input signal Codk of a frequency domain, respectively by the fast-Fourier-transform (FFT) circuit group 4 which consists of the fast-Fourier-transform circuits 41 and 42, --4K, --4N. (f) (k= 1, ...N)
Cod1 (f) and Cod2 (f) and --Codk (f) and --CodN (f)
(15)
It is alike and is changed. (15) Input signal Codk of the frequency domain of a formula (f) carries out the discrete Fourier transform of the input signal of each receiving antenna, and has become what was divided into the sub band of a frequency domain. These input signals Codk A differential recovery / amplitude compensating circuit 5 gets over [differential-] and compensates [amplitude-], and (f), and (k= 1, ...N) are the differential recovery signal Dk. (f) (k= 1, ..N)
D1 (f) and D2 (f) --Dk (f) --DN (f) (16)
It is outputted by carrying out. input signal Codk of the frequency domain acquired from the input signal received from each receiving antenna in this (f) (-- k= -- the maximum ratio composition is performed 1, 2, --, by carrying out weighting by N) Namely, synthetic input signal R3 of a frequency domain (f) is [0059].
[Equation 5]

$$R_3(f) = \frac{\sum_{K=1}^{N} |C_{odK}(f)|^2 D_K(f)}{\sum_i |C_i(f)|^2} \qquad (17)$$

[0060] It becomes. Here, it is denominator sigma|Ci. (f) |2 It is a standardization coefficient.
[0061] That is, if an operation as shown in a formula (17) in the maximum ratio composition circuit 10 is performed using the input signal changed into the frequency domain acquired from the fast-Fourier-transform (FFT) circuit group 4, and the differential recovery signal acquired from the differential recovery / amplitude compensating circuit 5, the maximum ratio composition will be made about all the bands for every band where sub band division of the input signal was carried out. It restores to the input signal of the maximum-ratio-compounded frequency domain by receiver 9a.
[0062] Thus, according to the form of this operation, frequency conversion of the OFDM differential modulation signal received by the receiving-antenna group 1 is carried out to baseband signaling. By getting over, after changing an input signal into the signal of a frequency domain by the fast-Fourier-transform (FFT) circuit 4, carrying out

weighting of the output of a differential recovery / amplitude compensating circuit 5 and the maximum ratio composition circuit's 10 performing the maximum ratio composition for every band By the synthetic receiving method of conventional diversity reception equipment, the influence of the intersymbol interference by the multi-pass and frequency-selective phasing which have not been removed can be suppressed.

[0063] Thus, when space diversity is constituted from two or more receiving antennas and synthetic reception is performed with the form of each operation of this invention in the case of transmission of the wide band signal accompanied by a multi-pass or frequency-selective phasing, By performing compensation and the maximum ratio composition (or the maximum ratio composition) for every band, after carrying out the discrete Fourier transform of the reception output of each receiving antenna and dividing into the sub band of a frequency domain Compared with the composite system in the conventional diversity reception, the big diversity reception of an improvement effect becomes possible. In case the technology of this invention receives the ground system television broadcasting by the move receiving set of the present ground system television broadcasting, the receive section of FPU (Field Pick-upUnit) or future QAM, VSB, or the OFDM method with a move receiving set or a portable receiving set, it is the very useful technology in which the rate of reception is sharply improvable.

[0064]

[Effect of the Invention] As explained above, according to this invention, the signal by which multiplex was carried out in the reference signal by the transmitting side is received by two or more receiving antennas. Carry out frequency conversion of each input signal to the signal of a predetermined band, and each conversion signal is divided into the sub band of a frequency domain. Since it carries out by putting in block the compensation and the maximum ratio composition based on a transfer function of the transmission line which contains a receiving antenna about each sub band division signal and the synthetic input signal is outputted When receiving a wide band signal under a multi-pulse or phasing environment, it can operate stably, and a big improvement effect can be acquired like the case of narrow-band signal reception.

[0065] Moreover, according to this invention, receive a transmission signal by two or more receiving antennas, and frequency conversion of each input signal is carried out to the signal of a predetermined band. Since each conversion signal is divided into the sub band of a frequency domain, it carries out by putting the maximum ratio composition in block about each sub band division signal and the synthetic input signal is outputted When receiving a wide band signal under a multi-pulse or phasing environment, it can operate stably, and a big improvement effect can be acquired like the case of narrow-band signal reception.

[Translation done.]